ENHANCED BURNER PERFORMANCE GAS RANGE SYSTEM AND METHOD

BACKGROUND

[0001] The invention relates generally to a gas range system and more particularly, to enhancement of burner performance of a gas range system for a cooking appliance.

[0002] Conventional gas operated cooking appliances, for example gas cooktops, have one or more burners, in which gas is mixed with air and burned. The burner typically comprises an orifice and venturi assembly for the entrainment of air by mixing air with the gas required to generate the burner power output. The process of drawing air into the gas stream, upstream of the burner is sometimes referred to as "primary entrainment." The gas is extracted from a supply device, for example a gas supply network and fed to a burner via a gas feed line. In conventional systems, the gas is supplied at a pressure of the natural gas supply source. This flow of the gas is then mixed with air in the venturi assembly, which provides the primary aeration of the burner.

[0003] Further, the burner also comprises multiple burner ports that stabilize the flames for cooking. Additional air is entrained into the fuel downstream of the burner ports sometimes referred to as secondary entrainment. The combined primary and secondary entrainment of air into the fuel provides the reactants required for complete combustion of the fuel delivered to the burner ports. Because such secondary entrainment occurs downstream of the burner ports, in a region in which cooking and handling activities takes place, it is often desirable to limit the reliance on secondary entrainment, thereby limiting the size and volume of flames. Consequently, for higher capacity burners, it may be desirable to boost primary entrainment.

[0004] Many specific techniques have been developed and are in use to enhance primary entrainment for gas range systems by adding mechanical energy to the system through either work or heat For example, in some systems a fan or a blower may be employed to add energy to the air for enhancing the aeration of the fuel. The fan or a blower is placed near the burner and the airflow rate required for mixing with the fuel,

as a function of required burner power output, is controlled via the speed of the fan or blower. In certain other gas range systems, adding energy to the burner system by heating the fuel stream enhances the primary entrainment.

[0005] However, while certain gas range systems using these techniques may provide increased primary air entrainment, they may not affect enough enhancement to operate within the industry standards for emissions and fabric ignition. That is, existing systems may not provide the desired degree of primary entrainment to support the combustion of higher fuel flow rates, while limiting secondary entrainment and flame lengths. In general, these primary entrainment enhancement concepts are not configured to prevent a condition wherein the mechanism for augmenting primary aeration fails while fuel continues to flow at a high rate, thereby not satisfying the industry standards with respect to emissions and fabric ignition.

[0006] Certain other systems employ open-loop control or closed-loop control to regulate the gas flow for optimum burner performance based upon inputs from a user of the cooking appliance. Such control may be based upon, for example, the type of gas burned and the required burner fuel to air ratio, and by measuring an existing flow of gas. While such control mechanisms for the gas range system have proven valuable in enhancing the burner performance by utilizing the inputs from the user and the measurement of the existing gas flow, the control is limited to enhancing the burner output using the existing feed pressure of the gas from the gas feed line, thereby limiting the peak burner output value through primary air entrainment.

[0007] Accordingly, it would be desirable to develop a gas range system that has enhanced burner performance achieved through primary aeration of the burner, while satisfying industry standards for emissions and fabric ignition. It would be advantageous to provide a system that could increase the delivery pressure to the gas orifice and venturi assembly for improving the primary air entrainment, while maintaining control of the burner power output via controlled gas flow to the gas burner system. Furthermore, it would be desirable to control the flow of the fuel to the burner in a condition that does not require primary aeration enhancement to satisfy industry standards for emissions and fabric ignition.

BRIEF DESCRIPTION

[0008] Briefly, in accordance with one aspect of the present invention an enhanced gas range system includes a pressure regulator adapted to regulate a gas flow from a gas feed line. The system also includes a gas fuel boost pump disposed downstream of the pressure regulator and adapted to increase pressure of the gas flow received from the gas feed line. A gas burner is disposed to receive the gas flow from the gas fuel boost pump.

[0009] In accordance with another aspect of the present invention, a method of enhancing performance of a gas burner comprises actively increasing pressure of a gas flow through a gas feed line via a gas fuel boost pump and regulating the gas flow of the gas fuel boost pump based upon a user-defined input to regulate a burner heat output to a desired burner output.

DRAWINGS

[0010] These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

[0011] FIG. 1 is a diagrammatical representation of an exemplary gas range system for use in a gas operated cooking appliance according to one aspect of invention;

[0012] FIG. 2 is a diagrammatical representation of an exemplary gas range system for a gas operated cooking appliance according to another aspect of invention;

[0013] FIG. 3 is a diagrammatical representation of an exemplary gas range system for a multiple burner gas operated cooking appliance;

[0014] FIG. 4 illustrates process steps for flow control of a gas fuel in gas range system of FIG. 1; and

[0015] FIG. 5 illustrates process steps for flow control of a gas fuel in gas range system of FIG. 2.

DETAILED DESCRIPTION

[0016] FIG. 1 illustrates a gas range system 10, according to an embodiment, for use in a gas operated cooking appliance, such as, but not limited to, gas stove, gas cookers, gas hobs, and gas ovens. In the embodiment illustrated in FIG. 1, gas range system 10 receives a supply of combustible gas from a supply line 12 via a pressure regulator 14. A conduit, such as tubing 16 then delivers the pressure regulated gas to a gas fuel boost pump 18 located downstream of the pressure regulator 14. As described in greater detail below, based upon user-defined inputs 20, flow control circuitry 22 coupled to the gas fuel boost pump 18 regulates the gas flow through the gas fuel boost pump 18. In operation, the gas range system 10 receives a gas flow from a supply, for example, a gas supply network, gas cylinder, gas tank and so forth.

[0017] Typically, the gas flow is received from the supply device at the natural gas supply pressure that may be about 5 to 10 inches of water column. This flow of the gas is received by the gas fuel boost pump 18 via the gas tubing 16. According to a presently contemplated embodiment, the gas fuel boost pump 18 is a variable speed pump, wherein the flow of gas through the gas fuel boost pump 18 is controlled by controlling the speed of the pump. Alternatively, the gas fuel boost pump 18 may be a variable displacement pump where the flow of gas through the gas fuel boost pump 18 may be controlled by controlling the displacement of the pump.

[0018] The gas fuel boost pump 18 is coupled to the flow control circuitry 22 that is configured to regulate the gas flow through the gas fuel boost pump 18 based on user-defined inputs 20. Further, the flow control circuitry 22 is also illustrated including an interface 24, a controller 26 and a memory device 28. The interface 24 is configured to receive the user-defined input 20 and transmit a signal representative of the user-defined input 20 to the controller 26. According to an embodiment, the user-defined input 20 is a desired burner output. The desired burner output may be specified as a BTU rating value that is a measurement of the heat generated by a gas

burner, as described below. Alternatively, the required burner output may be specified via a required pressure of the gas flow for generating a specified output. Additionally, the user-defined inputs 20 may include, without limitation, type of gaseous fuel and an altitude of the geographical location of the installation of the gas range system 10. The gaseous fuel used for the gas range system 10 may include, for example, natural gas, liquefied natural gas, propane, butane and so forth. The user input 20 may be provided by a user of the gas range system 10 via an input system for example, a knob control system, a touch control system and so forth.

[0019] The controller 26 is configured to calculate the desired gas flow based upon the user-defined inputs 20, and may reference data stored in the memory device 28. The reference data stored in the memory device 28 may include preset data describing the requisite gas flow as a function of the burner heat output for a gas type and/or a burner type.

[0020] The controller 26 transmits signals representative of the calculated gas flow to the gas fuel boost pump 18 via transmission media such as, but not limited to, infrared, radio frequency and electromagnetic media. As mentioned above, the output pressure from the gas fuel boost pump 18 may be used as a control mechanism for controlling the burner output via adjusting the speed or displacement of the gas fuel boost pump 18. In certain cases, where no primary air entrainment enhancement is required, the control mechanism as discussed above automatically reduces the gas flow through the gas fuel boost pump 18 to a minimal gas flow value. The flow of gas through the gas fuel boost pump 18 at the required pressure as calculated by the controller 26 is then fed to downstream gas circuitry described below. It should be noted that controller 26 may include various types of analog or digital circuitry, as well as software for the operation of the circuitry. The controller may thus be "hard-wired" or based upon application-specific or general purpose processors, and related circuitry (e.g., signal conditioning and filtration circuitry, analog-to-digital and digital-to-analog conversion circuitry, and so forth).

[0021] In the illustrated embodiment, the boost pump 18 delivers gas flow to an orifice 30 that controls the flow of the gas to be fed into a gas burner 32.

Alternatively, the gas burner 32 may receive the gas flow via a plurality of orifices 30 that may be located proximate a venturi 34 to achieve primary air entrainment in the gas flow in a relatively smaller distance (e.g., height). It should be noted that the size of the orifice 30 may be selected based on such factors as the relation between the gas flow rate and a pressure drop across the orifice 30. The gas flow is further directed inside the venturi 34 that is located downstream of the orifice 30. Downstream of the venturi 34, the gas and air mixture exits the burner via burner ports 36. The ports 36 are typically above a cook top surface 38 in a range application, although other configurations could be envisaged.

[0022] The gas flow directed into the venturi 34 entrains the primary combustion air to produce the primary aeration 40 for achieving the required burner power. Subsequently, the secondary air entrainment occurs as the gas and air mixture exits the burner ports, as indicated as reference numeral 42. The secondary air entrainment 42 at the burner ports 36 results in the flames that are used for the cooking and heating operations of a user of the gas range system 10.

[0023] FIG. 2 illustrates an exemplary gas range system for a gas operated cooking appliance 44 according to another aspect of invention. In the exemplary embodiment of FIG. 2 a transducer 46 may be placed upstream of the gas burner 32 at a predetermined location to measure a parameter of the gas flow at the predetermined location. Typically, the transducer 46 is located upstream of the orifice 30. It should also be noted that the flow control circuitry 22 is coupled to the gas fuel boost pump 18 and the transducer 46 for regulating the gas flow through the gas fuel boost pump 18 based upon the user-defined inputs 20 and a signal received from the transducer 46.

[0024] In the embodiment of FIG. 2, the flow control circuitry 22 includes the controller 26 that calculates a desired gas flow based on the user-defined input 20 and the signal received from the transducer 46. Further, the controller 26 utilizes reference data stored in the memory device 28 to calculate the desired gas flow for achieving the desired burner output, and transmits the signal for regulating the gas flow from the gas fuel boost pump 18. Subsequently this gas flow from the gas fuel

boost pump 18 is directed to the venturi 34 via the orifice 30 to obtain the primary entrainment 40 by mixing the gas with air. Further, the secondary air entrainment 42 of the gas flow is achieved at the burner ports 36 to generate the required burner output. The transducer 46, in general, detects a parameter of the gas flow from the boost pump 18, such as pressure or flow rate. The arrangement of FIG. 2, then, permits closed-loop control of the gas supply to the burner.

[0025] In another embodiment, illustrated in FIG. 3, the present technique may be employed for a gas range system 52 with multiple gas burners 32. The gas range system may implement open-loop control of the gas flow via the gas fuel boost pump 18. Additionally, the gas range system 52 may implement closed-loop control of the gas flow by coupling the measurement response from a transducer, such as transducer 46 discussed above, with the controller 26 to calculate the required gas flow. Further, the gas range system 52 may have individual gas fuel boost pumps 18 coupled to each of the plurality of gas burners 32 to regulate the gas flow for the individual gas burners 32 based upon the user-defined input 20. Alternatively, the gas range system 52 may have a single gas fuel boost pump 18 wherein, the gas fuel boost pump 18 is coupled to the plurality of the gas burners 32. A throttling valve 54 may be coupled to each gas burner 32 to regulate the individual gas flow for each burner 32.

[0026] It should be noted that various other configurations may be envisaged in practice, based upon the principles described herein. For example, in a typical range application, a number of burners may be provided with various heating capacities. In such applications, only one or two of the burners may utilize the flow-boosted approach of the present technique, while other burners may be supplied with combustible fuel in a conventional manner (i.e. directly from the gas supply). In such implementations, the gas supply may be manifolded to supply all of the burner circuits, with only one or specific conduits downstream of the manifold having a flow or pressure boosting arrangement of the type described herein. If, on the other hand, boosting is desired for all burners, a manifold may be provided downstream of the boost pump to receive boosted flow or pressure from the pump.

[0027] FIG. 4 represents a flow chart of exemplary logic, designated generally by reference numeral 60, for achieving an open-loop control of the gas flow in a gas range system 10 via a gas fuel boost pump 18. The process begins at step 62 where the controller 26 receives a user-defined input 20 from a user of the gas range system 10. The user-defined input may be a required burner output that may be specified as a BTU rating for the burner, or simply a calibrated level, rate, or portion of a range of output values. Also, as noted above, the user-defined inputs 20 may include the type of gaseous fuel being used for the gas range system. Additionally, the user-defined input 20 may be a type of the burner employed in the gas range system 10. Further, the controller 26 may regulate the gas flow based on the location of the installation of the gas range system 10 by adjusting the required gas flow as a function of an altitude or barometric pressure of the geographical location of the place of installation.

[0028] At step 64 of FIG.4 the user-defined input is converted to a signal via an interface 24, and this signal is received by the controller 26 for regulating the gas flow. Next, at step 66 the system determines the output signal for the gas flow to be sent to the gas fuel boost pump 18 based upon the user-defined input 20 and the internal references data stored in the memory device 28 that include preset data describing the desired flow as a function of the burner heat output for a gas type, a burner type, an altitude, and so forth. Subsequently, this signal is sent to the gas fuel boost pump 18 at step 68. At step 70 the gas fuel boost pump 18 actively increases or decreases the pressure of the gas flow, and this gas flow is provided to the gas burner 32 to generate the required burner output.

[0029] FIG. 5 illustrates exemplary control logic 80 implemented by the control circuitry 22 to provide a closed-loop control of the gas flow to the gas range system 10. In particular, the process begins at step 62 where a user-defined input 20 is received by the system. At step 64, the user-defined input 20 is converted into a signal to be used for the flow regulation of the gas in the gas range system 10. Further, at step 66 an output signal for the gas flow is decided based on the user-defined input 20 and the internal references stored in the memory device 28. This signal is then sent to the gas fuel boost pump 18 to regulate the flow of gas in the gas

range system 10. At step 82, the system 10 receives a signal measuring a parameter of the gas flow at a predetermined location via a transducer 46.

[0030] As shown in step 84, the system 10 then compares the actual measured value of the gas flow parameter with a predetermined value to decide whether the gas flow provides the required burner output. If the measured gas flow parameter is not consistent with the required gas flow, the system 10 returns to step 66 to recalculate the desired gas flow. If the measured gas flow as measured by the transducer is consistent with the required gas flow, the system proceeds to step 70. At step 70, the gas fuel boost pump 18 actively increases or decreases the pressure of the gas flow and this gas flow is provided to the gas burner 32 to generate the desired burner output.

[0031] As will be appreciated by those skilled in the art, the present system enhances the burner performance by improving the primary air entrainment 40 of the gas, while maintaining a control of the burner output. Additionally, the improvement in the primary air entrainment 40 of the gas enables production of high heating output levels, while satisfying industry standards for emissions and fabric ignition for the flames generated at the gas burner ports 36 resulting from the secondary air entrainment 42.

[0032] The various aspects of the method described hereinabove have utility in gas operated cooking appliances for example, gas cooktops, gas cookers, gas hobs, and gas ovens. These appliances use fuel such as, natural gas, liquefied gas and so forth that are combusted to produce heat. As noted above, the method described here may be advantageous for such systems for enhancing the burner performance of the cooking appliance by improving the primary air entrainment of the gas while satisfying industry standards for emissions and fabric ignition.

[0033] While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.